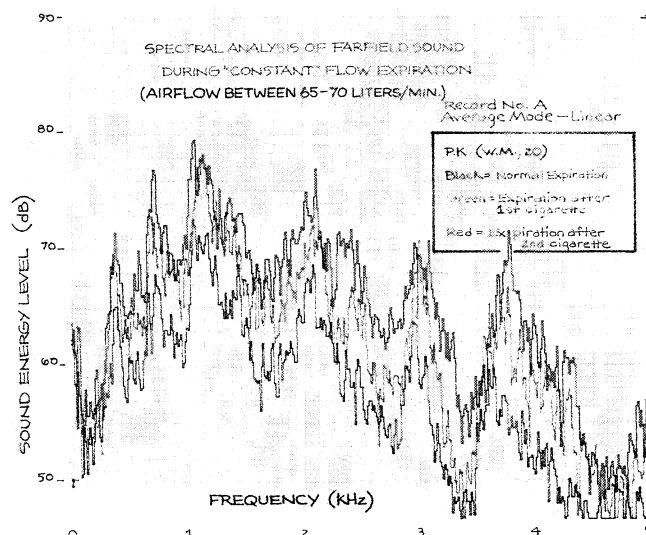
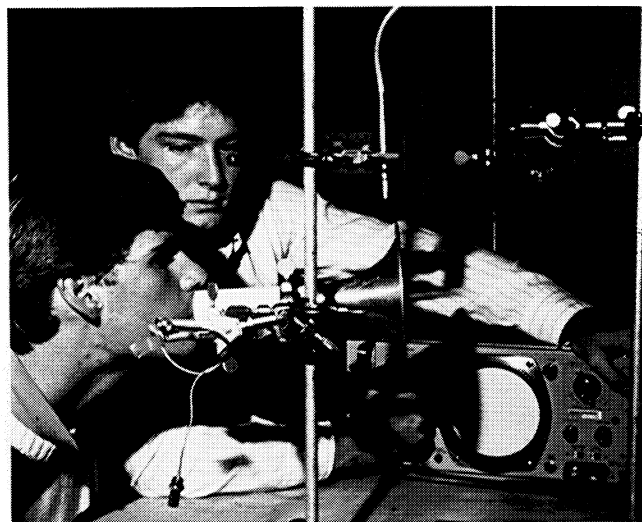


Lung Diagnosis

Disabling lung illnesses may develop from exposure to adverse occupational or environmental conditions, innate defects in the anatomy or function of the lungs, allergic responses, asthma, prolonged cigarette smoking and other conditions. Early detection, accurate diagnosis and immediate initiation of therapy improve the chances for successful treatment to forestall later stages of pulmonary illnesses. There is evident need for new, more sensitive, and more specific methods of insuring early detection of pulmonary abnormalities.

NASA research in aeroacoustics, the study of aircraft sound production toward reducing noise and vibration, has provided a theoretical basis for a mathematical-physical model of the production of human respiratory sounds, specifically "breath sounds." In theory, a particular pulmonary illness causes characteristic anatomic changes or changes in the reactivity of the bronchi, and therefore of airflow through different regions of the lung. Since early changes in respiratory response to a variety of stimuli are indicators of later disease, it is imperative to develop highly sensitive methods of detecting and following the time course of such early changes.

A theory of breath sound generation based on the interactions of vortices in the pulmonary airways has been developed and validated through extensive test data acquired by Langley Research Center/Medical College of Virginia (Richmond) researchers, using instrumented lung models they have developed (upper left). The intent of the project is to develop a technique of sufficient sensitivity to break down human respiratory sounds—as these sounds are changed by dysfunction—into their spectral frequency and amplitude components. In human testing (upper right), changes in breath sounds in the pulmonary airways are recorded and analyzed by a number of complex instruments normally associated with aeroacoustic research. The graph shows the marked



changes that occur in the sound spectrum of a young healthy subject after inhaling cigarette smoke; the black line shows normal expiration, green represents expiration after one cigarette and red indicates expiration after a second cigarette.

The research team includes Langley aeroacoustics experts Dr. Jay C. Hardin and Dr. John M. Seiner; Dr. John L. Patterson, Jr., principal investigator; Joseph E. Levasseur, together with medical and pre-medical students and collaborating faculty of the Medical College of Virginia; and the NASA-sponsored Research Triangle Institute Applications Team, Research Triangle Park, North Carolina. Bruel and Kjaer Instruments, Inc., Marlboro, Massachusetts, is supporting the project with engineering consultation and equipment. Interested in the system's commercial potential, Bruel and Kjaer predicts a market for a diagnostic and monitoring device in industrial employee check-up centers, as well as in the offices of specialists in respiratory disease, in clinics and in hospitals.